Improvements in or relating to extrusion dies for producing tubing from synthetic plastics

Publication number: GB987809
Publication date: 1965-03-31
Inventor: MORRIS PETER ALLAN; COOPER JOHN LESLIE EDWARD
Applicant: COSHAM ENGINEERING DESIGNS LTD
Classification:
- international: *B29C47/28;* B29C47/20;
- European: B29C47/28B
Application number: GB19630010035 19630313
Priority number(s): GB19630010035 19630313

Abstract of **GB987809**

987,809. Extrusion dies. COSHAM ENGINEERING DESIGNS Ltd. March 12, 1964 [March 13, 1963], No. 10035/63. Headings B5A and B5B. A crosshead extrusion die for preparing synthetic plastics tubing 21 comprises a flow channel 1 leading tangentially to an annular or involute stationary flow chamber 2 substantially encircling a rotatable die body 5A, 5B within which an annular flow path 4 leads from the flow chamber 2 to the concentric die lips 8 where the tubing is extruded. The annular flow path 4 includes a portion 7 of tapering cross-section. A plurality of flow paths 3 lead tangentially from chamber 2 to annular flow path 4. The die body 5A, 5B is rotatably mounted in bearing and sealing rings 10, and is driven from electric motor 15 through a chain drive and pinion wheel 19. Thermostatically controlled electrical heating jackets 11, 22 are provided. Cooling means for the extruded tubing pass through bore 20 in the die. The extruded tubing is collapsed to form a film.

FIG.1.

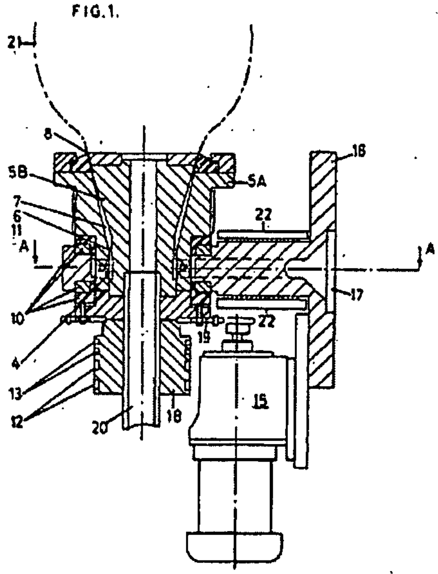
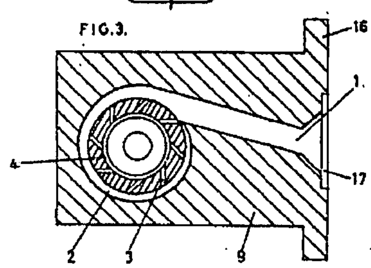


FIG.3.



PATENT SPECIFICATION

987,809

DRAWINGS ATTACHED

987,809

Inventors: PETER ALLAN MORRIS and JOHN LESLIE EDWARD COOPER

Date of filing Complete Specification: March 12, 1964.

Application Date: March 13, 1963. No. 10035/63.

Complete Specification Published: March 31, 1965.

Index at acceptance:—B5 A (1G3B, 1G7B, 1G7C, 2A1, 2A3); B5 B21B

Int. Cl.:—B 29 d

COMPLETE SPECIFICATION

Improvements in or relating to Extrusion Dies for producing Tubing from Synthetic Plastics

We, COSHAM ENGINEERING DESIGNS LIMITED, a British Company, of 62a, High Street, Cosham, Hampshire, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to extrusion dies and in particular to extrusion dies for producing tubing from synthetic plastics.

Where such dies are used for the manufacture of tubing having a wall thickness sufficiently thin to allow the finished tube to collapse into a flat form, one manufacturing difficulty lies in the fact that the running off speed of the extrusion is limited by the rate at which the extrusion can be cooled, it being essential that the extrusion shall be in, or substantially in, its set condition before it is allowed to collapse into its flattened state.

The portion of the tubing that extends between the orifice of the extrusion die and the collapsed stage of the tubing is known in the art as the 'blown bubble' and by cooling this bubble the running off speed can be increased. Such cooling can be effected by external air cooling.

It is also possible to cool the bubble by cooling means disposed inside the bubble or by causing a rapid air change to take place within the bubble, such internal cooling enabling a greatly increased running off speed to be achieved.

To enable access to be had to the inside of the bubble, for said internal cooling purpose, a fairly large access aperture must be formed in the extrusion die. Such an aperture, in turn, requires the use of a "Side Fed" die since an "End Fed" die precludes the use of internal cooling means because of the die construction.

The use of a "Side Fed" die introduces a further manufacturing difficulty in that "weld lines" are formed, "weld lines" being an expression in the art to define an actual reduction of material gauge due to the joining up of two separate material flows paths travelling circumferentially around the die in opposite directions.

A further manufacturing difficulty is that the lips of the extrusion die must be perfectly symmetrical since the slightest unevenness will result in undesirable imperfections in the finished product.

The present invention provides a new form of extrusion die that avoids all of the above manufacturing difficulties.

According to the present invention an extrusion die for producing tubing from synthetic plastics comprises a flow channel leading to a flow chamber encircling, or substantially encircling, a rotatable die body, and an annular flow path in the die body, said annular flow path leading from said flow chamber to the lips of the die from which the synthetic plastics is extruded in the form of a tube, the die body and the annular flow path therein being rotatable relatively to said flow chamber.

Preferably the flow channel extends tangentially to the flow chamber and the rotatable die body is formed with a plurality of flow-paths interconnecting said flow chamber with the annular flow path in the rotatable die body.

The rotatable die body is formed with an axially extending open ended bore to permit cooling means to be passed into the tubing extruding from the die.

In order that the invention may be clearly understood, reference will now be made to the drawing accompanying the provisional specification showing, by way of example only, one particular embodiment of the present invention and in which:—

Fig. 1 is a side elevation, in cross-section, of the extrusion die;

Fig. 2 is a plan view of Fig. 1; and

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Fig. 3 is a cross-section through Fig. 1 taken along the line A—A.

As shown in Figs. 1 and 3 a stationary block 9 is provided that has a flow channel 1 leading to a stationary flow chamber 2 of involute form that presents a cross-section that reduces gradually in area from its inlet end, the flow channel 1 being so disposed that any flow of plastics therethrough will be directed substantially tangentially into the flow chamber 2. The block 9 is provided with a flanged end 16 so that it can be secured to a plastics extruder, for example by bolts passing through the flanged end, the flanged end having a recess 17 suitable for housing a filter unit and leading to the flow channel 1.

The stationary flow chamber 2 is a recess extending around the circumference of a cylindrical opening in the block 9, said opening accommodating a rotating die body. The rotating die body is formed from outer and inner parts 5A and 5B respectively, the part 5A having a plurality of flow paths 3 interconnecting the fixed flow chamber 2 with an annular chamber 4 formed in the rotating inner part 5b of the die body. The flow paths 3 preferably lead tangentially into the annular chamber 4.

The annular chamber 4 leads to an annular metering restriction 6 between the parts 5A, 5B, which restriction in turn leads to a flow path 7 concentric with the axis of rotation of the rotating die body, the flow path 7 tapering in cross-section to a minimum at the concentric exit lips 8 of the die body.

The rotating die body 5A, 5B rotates in bearing rings 10 that are specially treated with an anti-scuffing process to give a long wearing life, and because of their close tolerance fit these rings also act as sealing rings restricting the flow of the plasticised material to the flow paths described.

Surrounding the die body 5A, in the region of the tapering flow path 7, is an electrically heated jacket 11 energised via slip-rings 12, the slip-rings 12 being carried by an extension of the part 5A of the die body or by a separate cylindrical body 18 concentric and rotating with the rotating die body.

The electrical supply to the jacket 11 is preferably thermostatically controlled. Preferably the thermostatic control is by means of a thermocouple sensitive to the temperature of the plastics material flowing through the tapering flow path 7, the voltage set up by the thermocoucple being brought out via slip rings 13 on the body 18.

The die body may be rotated by any suitable means and, as shown, this may be by means of an electric motor 15, suitably geared down if necessary, having a chain drive 14 coupled to a pinion wheel 19 secured to, and concentric with, the rotatable die body.

Extending axially through the rotating die body, including any parts secured thereto, such as the part 18, is a bore 20 through which cooling means can be passed into the bubble 21 of the plastic film.

The stationary block 9 is preferably provided with heating means 22, for example thermostatically controlled electric heating means.

In operation molten plastics is formed by the extruder along the flow channel 1 and into the stationary flow chamber 2. The plastics material then flows through the rotating and tangentially arranged flow paths 3 into the rotating annular chamber 4 in the core 5B of the die body. The plastics material then changes its direction of flow by 90° to pass upwardly through the metering restriction 6 and thence into the tapering flow path 7 from which it escapes via the concentric lips 8 to form the bubble 21 in the surrounding atmosphere.

Since the extruded bubble 21 will eventually collapse into a flattened condition and be carried away by suitable conveyor means travelling at the running off speed of the tube it follows that the tube 21 will be held against rotation and that the die lips 8 will rotate relatively to the finished tube. Because of this relative rotation, any slight unevenness or non-concentricity of the die lips 8 resulting in a slight uneveness of extrusion causes such slight unevenness to be spread around the tube being extruded.

There will also be an even spread of the plastics material around annular chamber 4 of the die core 5B due to the rotary smearing action of the plasticised material as it is forced through the tangential flow paths 3. This action results in the elimination of all weld or spider lines and other undesirable imperfections in the extruded film 21 as at present experienced in conventional dies used for extruding collapsible tubing.

As shown in Fig. 3 the involute flow chamber 2 is preferably terminated such that it does not subtend an arc of a full 360°, the involute flow chamber terminating short of its return point to the flow channel 1.

The speed of rotation of the die body 5A, 5B depends upon the operating conditions, but speeds in the range of 1/10 to 2 r.p.m. have been found to be suitable.

The invention may be modified in several ways as may fall within the scope of the appended claims.

Thus, for example, the involute flow chamber 2 may, if desired, be of annular form, such an annular flow chamber 2 preferably terminating short of its return point to the flow channel 1.

Also, the die body 5A may be heated, if desired, by induction heating, for example at mains frequency. The slip rings that would otherwise have energised the heating jacket 11 being used to convey the electrical supply to said induction means if the induction means

rotates with the die body.

It will be seen that the present invention provides a new form of extrusion die having an axially extending bore 20 whereby cooling means can be inserted into the bubble to facilitate a high running speed, and whereby the conventional difficulties relating to weld lines and imperfections in the final product have all been eliminated.

WHAT WE CLAIM IS:—

1. An extrusion die for producing tubing from synthetic plastics comprising a flow channel leading to a flow chamber encircling, or substantially encirlcing, a rotatable die body, and an annular flow path in the die body, said annular flow path leading from said flow chamber to the lips of the die from which the synthetic plastics is extruded in the form of a tube, the die body and the annular flow path therein being rotatable relatively to said flow chamber.

2. An extrusion die as claimed in claim 1 and wherein the flow channel extends tangentially to said flow chamber.

3. An extrusion die as claimed in claim 1 or claim 2 and wherein the rotatable die body is formed with a plurality of flow paths interconnecting the flow chamber with the annular flow path in the rotatable die body.

4. An extrusion die as claimed in any of claims 1 to 3 and wherein the rotatable die body is formed with an axially extending open ended bore to permit cooling means to be passed into the extruded tubing.

5. An extrusion die as claimed in any of claims 1 to 4 and wherein the flow chamber is of involute form.

6. An extrusion die as claimed in any of claims 1 to 4 and wherein the flow chamber is of annular form.

7. An extrusion die as claimed in claim 2, or any claim appended thereto, and wherein the flow chamber commences where it is joined tangentially by the flow channel but terminates short of its return point to said tangential flow channel.

8. An extrusion die as claimed in any of claims 1 to 7 and wherein the rotatable die body includes electrical heating means.

9. An extrusion die as claimed in claim 8 and wherein the electrical supply to said heating means is thermostatically controlled.

10. An extrusion die as claimed in any of claims 1 to 9 and wherein the annular flow path in the rotatable die body tapers in cross-section to a minimum at the exit lips of the rotatable die body.

11. The improved extrusion die substantially as hereindescribed.

12. The extrusion die specifically as hereindescribed with reference to the drawing accompanying the provisional specification.

HUGHES & YOUNG,
7, Stone Buildings, Lincoln's Inn,
London, W.C.2.
Agents for the Applicants.

Leamington Spa: Printed for Her Majesty's Stationery Office, by the Courier Press (Leamington) Ltd.—1965. Published by The Patent Office, 25 Southampton Buildings, London, W.C.2, from which copies may be obtained.

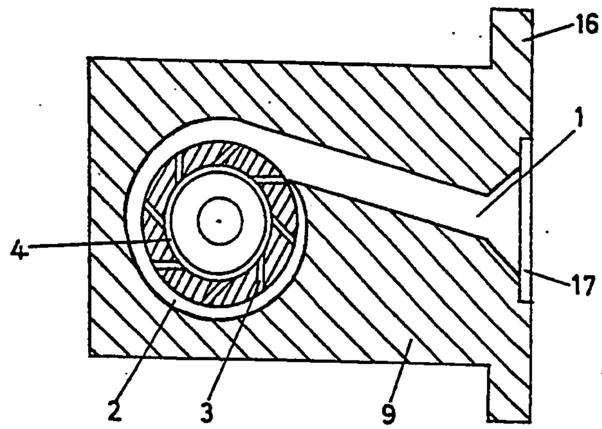

FIG.3.

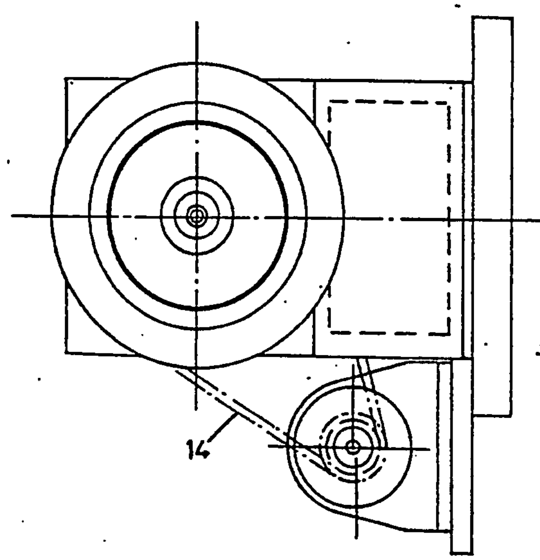

FIG.2.

987809 PROVISIONAL SPECIFICATION
1 SHEET *This drawing is a reproduction of the Original on a reduced scale*

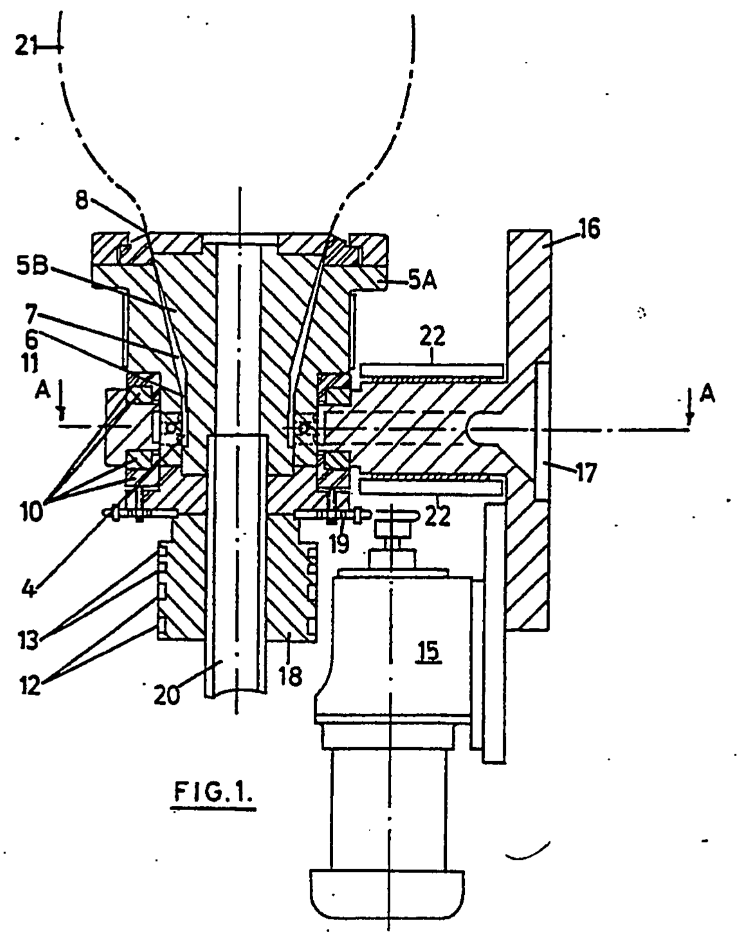

FIG.1.

.2.

987809 1 SHEET

PROVISIONAL SPECIFICATION

This drawing is a reproduction of the Original on a reduced scale

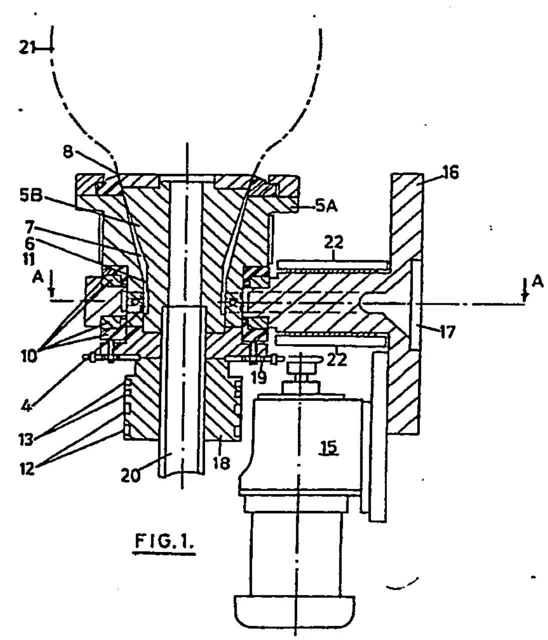

FIG.1.

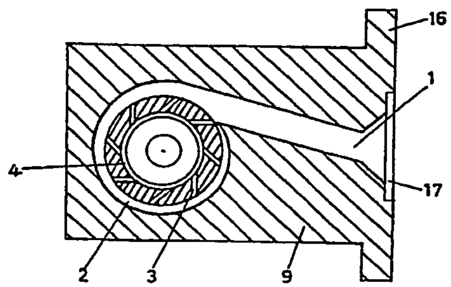

FIG.3.

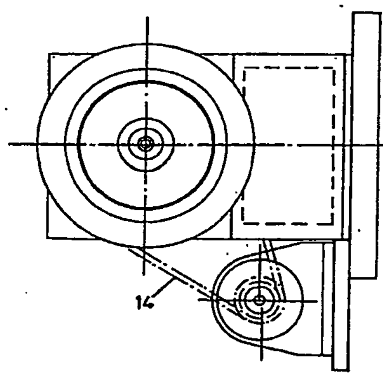

FIG.2.